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ABSTRACT

School architects, construction managers, and school administrators convened at a conference to examine the question of renovation or replacement of aging public schools, and to address issues from turn-of-the-century architectural features to sources of renovation financing. This paper contrasts the distinguishing characteristics of early-20th century and mid-20th century schools and addresses the unique design principles and materials typical of the facilities constructed during theses eras. Other topics include the evaluation and assessment of existing school buildings, the tools and techniques for condition assessment and management of K-12 renovation projects, construction management as a construction delivery method of school renovation, the role of the architect as construction manager, and construction scheduling. Final topics concern renovation programs that preserve valuable resources and alternative funding possibilities such as public/private development partnerships. Contains a list of conference speakers. (GR)

Renovating Early and Middle 20th Century Schools

Introduction

Like every major U.S. city, St. Louis' suburbs swelled during the 1950s and 1960s. Newly formed municipalities scrambled to accommodate the surging baby boomer generation, building hundreds of single-story, metal-framed schools that are now ripe for renovation. St. Louis is even better known for its rich collection of classic turn-of-the-century schools designed by William B. Ittner. Ittner's schools are renowned for their planning principles, attention to detail, and use of space. The firm he founded is still involved in the construction and renovation of educational facilities today.

St. Louis proved an excellent location for a conference on "Renovating Early and Middle 20th Century schools." The two-day conference, sponsored jointly by the Committee on Architecture for Education (CAE) PIA and the Construction Management (CM) PIA, drew approximately 150 professionals, including school architects, construction managers, and school administrators from Thursday, June 24 through Saturday, June 26.

Thursday evening and Friday afternoon, participants toured seven St. Louis area schools representative of both early- and mid-20th century styles. All demonstrated innovative solutions to renovation dilemmas while showcasing the design and construction strengths of St. Louis firms. Focused sharply on the issue of whether to renovate or replace existing schools, the conference addressed a wide variety of topics, from turn-of-the-century architectural features to sources of renovation financing.

Renovate or Rebuild

Renovate-or-rebuild questions must take into account such things as community support. Contributing to the decision are whether schools host multigenerational activities or year-round functions, or serve as a focal point for a neighborhood. When deciding whether to renovate, several speakers emphasized the importance of energy efficiency and technology issues. Electrical systems must be updated not only to handle multiple computers in each classroom, but also future changes in technology.

Funding

Funding a school renovation can be a large stumbling block. Several presentations addressed the new kinds of collaborative partnerships formed to help get needed upgrades accomplished, including joint efforts between state agencies and obtaining financing from energy service companies to repair or replace such things as boilers or lighting.

Construction Management

A school administrator, an architect, and a traditional contractor all discussed the benefits of construction management as a delivery method for school renovation, explaining that it can help improve communication, ensure that deadlines are met, and keep costs low. It can also provide owners with a greater level of control than the more traditional design/bid/build method.

Technology

One of the hottest topics, though, was the use of computers to determine whether to renovate an existing structure, or to tear it down and start anew. Software tools are available today that allow architects to plan and manage a school project, as well as assess the facility and come up with a numerical measurement of a school's overall condition. The following report highlights the discussions organized into four focused topics.

Schools of the Early and Middle 20th Century: Planning Principles, Anatomy, and Materials

Sessions in this focus topic distinguished between schools built in the early 1900s and those built during the baby boom era of the 1950s and 1960s. Speakers addressed the unique design principles and materials typical of the facilities constructed during these eras. In addition, a self-identified "typical client" described renovation challenges common to both early- and mid-1900s properties.

Comparison/Contrast: Early- and Mid-20th Century Schools

Some of the distinctions between turn-of-the-century and mid-1990s schools are summarized in the chart below.

Distinguishing Characteristics	
Early 20th Century	**Middle 20th Century**
Single building with multiple stories.	Several single- or two-story buildings, often connected by covered walkways in campus format.
Center of residential neighborhood. Civic icon.	Often built away from residential neighborhoods or a discreet presence.
Masonry construction and stone detailing.	Some masonry, many with steel framing, glass, and cementos panels. Some aluminum.
Main entrance elevated, up several steps.	Main entrance at grade. Several entrances.
Fence around school property.	No fencing.
Large windows, single pane, wood frames.	Large areas of continuous windows, steel or aluminum frames.
Mostly plaster walls, some glazed tile walls.	Often glazed tile walls.
High ceilings/structure.	Low ceilings/structure.
Wood railings.	Aluminum railings.
Wood floors, wood trim, built-in cabinets.	Asbestos-containing floor tile.

Terrazzo floors.	Terrazzo floors.
Unique features and detailing: bay windows, ceramic tile artwork, fireplaces, window moldings, terra cotta and stone work, skylights.	Simple detailing, International Style aesthetic.
Hot water or steam heating systems with radiators.	Hot water heating systems with fin tubing.
Incandescent lighting.	Fluorescent lighting.
Sloped roofs, often slate.	Flat roofs.

Turn-of-the-Century Construction:

Robert O. Little, AIA, president of Wm. B. Ittner, St. Louis, teamed up with Glen Vanderlicht, St. Louis Public Schools' commissioner of buildings and grounds, to offer in-depth knowledge of the city's turn-of-the-century schools.

William B. Ittner (1864-1936), founder of the firm that Little now heads, designed nearly half of the 100 schools in the city of St. Louis. Today, two-thirds of these schools are in the National Register or are in National Register districts. Both Little and Vanderlicht are deeply involved in the restoration of such schools:

- Little, a member of the AIA Landmarks Advisory Committee, serves as special consultant to the St. Louis City Public Schools on matters of renovation and renewal
- Vanderlicht has directed a $300 million capital improvement program for the St. Louis Board of Education over the past 10 years, with additional multi-million-dollar projects currently underway.

Their discussion touched on such topics as the importance of preserving original ceramic tile mosaics and elegant woodwork in balustrades. Furthermore, both value central courtyards and light-filled atria, dislike the idea of adding security bars, and recognize the need for bringing technology into every classroom.

Three-Phased St. Louis Capital Improvement Program

During the $300 million Phase I of Vanderlicht's capital improvement program, which was completed in 1997, 100 schools were renovated and six new schools were built.

Phase II is now underway with a budget of $56 million, and a commitment to renovate four additional schools and build one new high school. Phase III, budgeted at $180 million, includes plans to build three new schools and reopen three that are now closed.

The Ittner Signature

Little referred repeatedly throughout his presentation to the many "surprises" and "unexpected delights" found in Ittner schools: a glazed terra cotta mosaic behind a hallway drinking fountain, stained glass inside a school entry, leaded glass bowls in auditorium ceiling fixtures.

His educational buildings, imbued with a sense of spaciousness, often feature:

- Open "H" and "E" plans
- "light wells" to bring in natural light
- beautiful architectural detailing
- combined gymnasium and auditorium
- libraries with carrels for individual study
- kindergarten rooms twice the usual size with bay windows and fireplaces
- domestic science and manual training areas
- large windows and skylights
- landscaping, with a transparent division between the interior and exterior
- gravity ventilation
- indoor plumbing and other "modern" conveniences.

Ittner was the first architect in the country to introduce many of the above-listed qualities, making him truly an innovator in school design at the turn of the century. The landmark building of his St. Louis career is the Soldan High School, which was toured during the conference.

In addition to his innovative ideas for creating learning environments, Ittner was a master of masonry who utilized brick detailing to its fullest. The diagonal brick pattern is a distinctive characteristic of an Ittner building.

Ittner's reputation for excellent design work spread his fame well beyond St. Louis, winning him commissions in over 100 school districts in cities across the nation, including Niagara Falls, Wichita, and Galveston.

School Buildings of the 1950s and 1960s

J. Steven Coffey, AIA, president of Kennedy Associates, St. Louis, broached the question of why schools built between the 1950s and the 1970s turned out as they did. In answering, he walked his audience through the demographic and social influences affecting nearly 200 years of education in this country. He started with one-room schoolhouses of the 19th century; moved through the baby boom of the 1940s and corporate migrations of the 1950s and 1960s; and ended with issues that face us today, like energy use, security, technology, and ADA requirements. It is concerns such as these that make renovating the single-story, metal-framed, glass-walled buildings that proliferated during the mid-20th century such a challenge.

The Baby Boom

With the baby boom came the introduction of 11 million children into the educational system and the construction of approximately 60,000 new classrooms each year between 1950 and 1960. There had been no money for educational spending during WWII – and little need – but the capital outlay per student skyrocketed starting in 1950.

Corporate Mobility

The haste to build more schools as quickly as possible may have been exacerbated by Americans' rush to move in other ways, too. Corporations shipped their executives and their families cross-country and back, as often as every year. In addition, families migrated en masse from urban centers to the sprawling suburbs. Overall, about 20 percent of the U.S. population moved every year, eliminating the sense of belonging and permanence that had permeated neighborhoods, cities, and family life in previous decades. Is it any wonder that schools were not built with community or longevity in mind?

The Bottom Line

There were several factors contributing to the ubiquitous single-story, metal-framed, glass-walled K-12 school buildings that sprung up in the 1950s and 1960s:

- 50 percent higher school enrollment
- mass movement to suburbs
- low tax base in suburbs for development of infrastructure or schools
- need for fast-tracked, simple schools
- emphasis on cheap construction, with quantity more important than quality.

Why Renovate?

According to Coffey, a school board's mandate to upgrade facilities usually emanates from one or more of three sources:

- Program requirements, including such things as curriculum and extended hours
- energy demands
- code requirements.

Curriculum requirements include such items as art classes and athletics, while extended hours might be necessary to accommodate pre- and after-school care of school-aged children. Or the school board might decide to convert a traditional school to a community center, which typically operates 12 to 16 hours a day.

The Renovation Decision

One common reason for school renovation is energy conservation, which affects three systems:

- Envelope (roof, walls, windows, slab)
- mechanical systems (steam or hot water upgrade)
- electrical and technology systems (power distribution, lighting sources, computers, security systems).

Coffey provided details and photographs to support his recommendations for each renovation consideration, from asbestos to higher-efficiency T8 lamps. He explained, "One of today's challenges is to retrofit building systems, envelope, and technology systems in a cost-effective way. But equally challenging is the process of defining the limits of responsible renovation and deciding whether to renovate or replace."

Retrofitting *Any* Older School Building

The process of renovating an older school to meet the performance needs of today's students, teachers, school administrators, and communities contains certain standard elements.

Though radically different in design, materials, and systems, schools from the turn of the century and those from the mid-20th century pose similar challenges. Not only are there the technology requirements of today, such as multiple in-classroom PCs, but there is also the need to provide the structural and systems flexibility that will enable school districts to adapt to future changes.

Additional retrofit issues include accessibility, energy efficiency, security, funding, and the use of school facilities for nontraditional, multigenerational, and community purposes.

Today's Renovation Issues

Conference leadership provided a handout that listed some of the renovation issues that affect both early- and mid-20th century schools:

- Fit of today's educational space requirements
- size requirements for libraries, gymnasiums, classrooms
- heating efficiency
- air conditioning requirements

- accessibility
- safety – railing heights, slip resistance, etc.
- security and surveillance
- durability of materials
- asbestos
- plumbing and electrical capacity
- technology integration
- condition of restrooms, shower rooms, kitchens, science labs, etc.
- expanded curriculum and programs that go beyond traditional school offerings
- spaces for multi-aged interaction, team teaching, project areas, etc.
- community use of buildings
- flexibility for shifting enrollment, class sizes, curriculum.

Current Issues Meet School Houses of the Past: Renovation of the East St. Louis Schools

In 1997, when Richard B. Wells accepted the position of director of business and operations, East St. Louis School District 189, he had to confront each and every one of the considerations listed above, and a litany of even more serious problems:

- 26 gravely neglected schools
- a 20-year history of emergency-only maintenance
- district expenditures of less than $1 million a year for maintenance
- one condemned building
- 10 additional schools with a functional life in excess of 100 years
- a merger that would raise the student population from 1,000 to 2,700.

The administrative and financial problems were so severe that the entire East St. Louis School District had been placed under state control.

Wells painted a grim image of the physical conditions under which students were expected to learn: classrooms with no electrical outlets, constant ceiling leaks, teachers continuously holding the fire alarm button to keep the alarm sounding, and rats in student restrooms.

Partnerships, Collaboration . . . and Remedies

Wells accepted responsibility for improving the desperate conditions and immediately enlisted the assistance of several state-level partners, including the regional school superintendent assigned to East St. Louis, among other school districts; the Illinois State Architectural Department; and the Capital Development Board in Illinois

Representatives of these agencies, together with a local architect, have served as reliable, strategic partners in the effort to rescue East St. Louis schools.

The Priorities and the Accomplishments

The district's progress in two short years has been amazing:

- Replaced roofs in 20 of 26 buildings
- added tuckpointing
- installed new external doors to all 26 schools
- upgraded electrical service to accommodate five computers per classroom and Internet connections
- installed new security systems
- replaced all fire alarm systems

- replaced boilers
- replaced windows
- updated lighting.

On a practical and extremely valuable level, Wells suggested several funding resources:

- Qualified Enterprise Zone Grant – federal grants to renovate existing buildings
- Capital Infrastructure Grant – Illinois state funds for additions or renovations
- Alternative Revenue Bond – Illinois fund

A Client's Request

Wells described himself as "your typical client" and closed with this request: "We school administrators may know nothing about architecture or construction, and we may not be able to communicate in your language. Give us the advice we need, in plain language."

Evaluation and Assessment of Existing School Buildings

Three presentations tackled the topic of choosing whether to renovate or abandon an existing school, and how to evaluate a building to be renovated.

One speaker delivered a concise yet complete overview of the complex issues of assessment, identifying four categories for consideration: physical, economic, educational adequacy, and community. He placed major emphasis on the importance of educational adequacy.

A second group of speakers concentrated on the first of these four categories – physical condition – and demonstrated the use of two integrated suites of software tools. The first tool leads architects through a detailed facility assessment and eventually produces a numerical measurement of overall physical condition called the Facility Condition Index (FCI). The second system helps users plan and manage project execution, including design and construction.

Current Issues Meet Schools of the Past

Lee Brockway, AIA, Principal Emeritus of Fanning/Howey Associates Inc., Michigan City, Ind., spoke on the need for procedures and guidelines to assist on the difficult renovate-or-abandon decision that many school administrators face.

Current Evaluation/Assessment Procedure

Brockway identified four major areas to consider when deciding whether to renovate or abandon an existing school, including physical, economic, educational adequacy, and community

Physical

He recommended extended visits to the buildings and the consistent use of objective tools to evaluate the condition of the physical property, including:

- Building envelope
- structural systems
- HVAC
- plumbing
- electrical
- materials and finishes
- site conditions.

School boards and the architects who serve them need some objective rating systems that allow for comparisons between the subject school and other buildings within the same district.

Economic Analysis
Acknowledging that the decision to restore or demolish a school is often a straightforward financial decision, Brockway listed the various items that must be factored into the economic analysis:

- Initial cost
- owning cost
- present value
- operating cost
- real estate value.

He recommended also completing a life-cycle cost analysis.

Educational Adequacy
Repeatedly, Brockway stressed the dominance of this factor – educational adequacy – when conducting school assessments. Among the considerations to take into account are
the standards, plan, or specifications that constitute an operational definition of educational adequacy; the evaluators and their experience; and the evaluators' knowledge of curriculum requirements and space programming

Educational adequacy can be broken down into two parts, building evaluation factors and site evaluation factors.

The building evaluation factors that Brockway recommended for inclusion are:

- Circulation
- student access to program spaces
- access for physically disadvantaged
- sizes and flexibility of program spaces, including:
- student commons
- library
- student services
- teacher support
- conference and planning
- amount, type, condition and adequacy of equipment
- technology equipment requirements
- lighting quality
- quality of the physical environment
- access to windows.

Site evaluation factors include:

- Adequacy of physical education and outdoor education spaces
- separation of playgrounds by age levels
- traffic paths and student safety
- access for service and safety vehicles
- parking
- community use
- signage.

Community Factors
Every successful renovation project discussed during the conference enjoyed strong community support. Often, explained Brockway, factors like a building's familiarity, location, architectural value, and use by the community will determine the level of the community's interest.

Unified, Comprehensive Assessment

After the evaluation in all four categories is complete, Brockway recommends quantifying the factors according to a logical system that recognizes the different needs of different grade-level organizations. A single consolidated document will enable school administrators to make the tough decision about renovating or replacing the school in question.

Tools and Techniques for
Condition Assessment and Management of
K-12 Renovation Projects

Seasoned school architects and construction managers invariably identify many of the same considerations when it comes to property assessment and project management. Consequently, conference participants immediately recognized the practical value of COMET and IMPACT, two proprietary software systems demonstrated by 3D/International.

3D/I

The presentation delivered by J. James Flynn, AIA, senior vice president of 3D/International in Orlando, and Carl Rabenaldt, senior vice president of 3D/International in Houston, drew on 3D/I's experience in the field of school renovation. The firm has completed more than 500 school assessments in the past 24 months. These assessments covered more than 65 million square feet and identified $2.5 billion in needed capital improvements.

Statistical Findings

Charts were used to summarize 3D/I's overall assessment findings, and they showed that the components that fail most, in order of decreasing frequency, are:

- Roof
- mechanical
- exterior
- electrical
- interior
- site
- structural.

These basic findings were no surprise, but 3D/I has also developed aggregate statistics detailing a wide range of findings. For example, there is the deficiency cost compared to the value of each component, the percentage of total building value that each component/system represents, and the deficiency percentages for each component system. 3D/I has determined that, across the country on average, it costs $124 per square foot to build a new school.

Various charts showed the breakdown of total work to be done by system. For example:

52 %	Architectural systems
30 %	Mechanical and plumbing systems
9 %	Electrical systems
6 %	Site/civil

Facility Condition Index (FCI)

Dr. Harvey Kaiser has developed a formula, based on industry standards, that will create a single numerical indicator of a school's overall physical condition. It is called the Facility Condition Index (FCI):

$$\text{FCI} = \frac{\text{Needed Repairs (\$)}}{\text{Replacement Value (\$)}}$$

According to industry standards, the resulting values are grouped in three broad bands:

FCI	**Condition**
<0.05	Good
0.05 through 0.10	Fair
>0.10	Poor

While it's common knowledge among school architects that deferred maintenance has resulted in some seriously neglected educational facilities, 3D/I has empirical proof: every one of the schools they evaluated has an FCI of at least 0.2, two times higher than the "best" poor rating of 0.10.

COMET

The software tool that allows 3D/I to generate FCI measurements for their clients is called COMET (Condition Management Estimation Technology). Field evaluators enter their observations into the database via handheld electronic devices. COMET captures and manipulates the raw data, and eventually produces the FCI. Because field specialists have continual access to the same database, consistent interpretations are more likely to result.

The Assessment Process

On most 3D/I assessment projects there are three teams, comprising specialists from 3D/I; local architects and engineers; and school staff, including principals, teachers, and facility maintenance personnel. Thanks to 3D/I's thorough documentation, the most valuable sources of assessment information have been pinpointed:

50 %	Walking the property
25 %	Reviewing client documents
25 %	Interviewing school staff and community representatives

The Power of Objective, Quantifiable Findings

Over a 50-year life cycle, renewal costs for the average project add $203.41 per square foot for replacement of worn-out materials and systems. So, in addition to generating the FCI, conference participants saw additional COMET capabilities such as life cycle analyses, future capital outlay forecastings, repair prioritization analyses, and preventative maintenance projections. Adding the cost of repairing deficiencies to forecasted renewal costs enables budgeting of required work over the life cycle of the building.

Said Rabenaldt, "Clients can see that it's a matter of 'Pay me now or pay me later.'"

He described one incident that clearly demonstrated COMET's benefits. Voters weighed in against a bond referendum for $376 million, then passed a second one two years later for $678 million after the results of a 3D/I assessment clearly highlighted the school's needs.

Data Import From COMET to IMPACT

The second proprietary software system demonstrated by Rabenaldt was IMPACT (Integrated Project and Project Accounting). COMET and IMPACT work together as an integrated system. When it's time to start planning and managing project execution – including design, construction, operations, and maintenance – data from COMET is imported directly into IMPACT.

Providing Services

3D/I forms multidisciplinary assessment teams with local architects to provide facility condition assessment services. 3D/I provides the software and the specialized expertise, while local architects bring an understanding of the owner's facility requirements, the local building codes, and an on-call availability for continuing consultation after the assessment is finished.

Renovation: Management Approaches

Construction Management (CM) as a construction delivery method for school renovation was one of the topics considered at the conference. It was approached from three different angles in discussions given by a client, an architect in the expanded role of designer/construction manager, and a traditional contractor functioning as a construction manager.

All three touted the benefits of the construction management approach, especially to clients. The school administrator, whose district migrated from a design/build approach to construction management, reported, "We would never go back."

Construction Management as a Construction Delivery Method for School Renovation

According to Dan Huffman, assistant Superintendent of Business Services for Public School District No. 1 in Fargo, N.D., the construction manager should function as the owner's foreman, safety inspector, staff member, and cheerleader.

So far, Huffman has explored four different "flavors" of construction management service:

- Extended architectural services, with a limited number of contractors
- management by the CM division of an architectural firm
- independent construction management firm
- preconstruction services by an architectural firm, followed by CM services from a CM company.

The nature and scope of a particular project guides Huffman toward the most appropriate option to meet that project's unique requirements.

Huffman cited five distinct advantages of construction management: owner representation, greater control over contracts and quality, better timeline control, improved communications, and cost savings.

Relationships

The dynamics between the designer, contractors, and owners change radically when contractual relationships change, and Huffman is convinced that project results are affected too.

For example, decisions are more likely to be attuned to the owner's requirements when there is an on-site construction manager who represents the owner. Under the design/bid/build approach, the on-site superintendent's commitment is to the prime contractor; and when issues of overhead and profitability come into play, the owner's interests may be compromised. In contrast, the CM's exclusive commitment is to the school board. The CM approach also allows the school district to contract directly with each contractor, thus enhancing administrators' control over quality.

Staff Extension

The single largest advantage of CM, according Huffman, is the continual on-premises involvement of a construction-knowledgeable professional. The on-site manager becomes, in effect, an extension of the school district staff, with responsibility for a number of project-critical functions:

- Coordinating construction fencing
- continuously monitoring progress
- tracking the budget
- ordering testing
- evaluating change orders
- identifying cost-reduction possibilities
- communicating with school administrators and all contractors
- coordinating any owner-provided construction activities.

When to Opt for Construction Management

Huffman identified five circumstances that could logically nudge a school district in the direction of construction management:

- When project timeline is an issue (which is almost always the case, said Huffman)
- when cost savings are possible (they are almost always possible, though Fargo hasn't yet appreciated this benefit)
- if the owner wants to supply some of the materials (e.g., telephone, security, computer technology, keycard entry)
- if the owner wants more project control
- when the project should be opened to more contractors (this could include prequalification).

Cost Savings

Huffman admitted that Fargo has not yet experienced much in the way of cost savings, although he identified the following sources of potential cost reductions:

- Reduced overhead and profit on subcontractors
- use of owner-supplied materials
- sales tax
- cost reductions recommended by construction manager during design and construction phases.

Selection Criteria

For school administrators new to the construction management approach, Huffman suggested the following selection considerations:

- Knowledge of construction
- experience with similar projects of similar size
- relationships within local architects, engineers and the contracting community
- previous relationships with school district
- cost of services.

Case Studies

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Huffman presented three case studies of four successful projects, each illustrating one of the construction management options employed on Fargo school projects:

- Eagles Kindergarten – extended architectural services
- Warehouse and Food Service Facility – construction management by architectural firm
- South High School – independent construction management
- new elementary school – preconstruction by architectural firm, then a CM firm.

The Role of Architect as Construction Manager

Brad Paulsen opened his presentation with the suggestion that we "challenge some of our beliefs as architects." He has worked both as a CM with an architectural firm and as an architect inside a construction management company.

The Pitfalls of Separating Design and Construction

If an approach, method, or system, is performing well, there's little incentive to change it. However, the conventional design/bid/build method of construction delivery brings a number of pitfalls, as Paulsen pointed out. These include process gaps that lead to extended timelines and disjointed project delivery; disputes between owners, architects, construction managers, and contractors; an overemphasis on low costs rather than value; and a lack of accountability for such things as cost overruns and missed deadlines.

Fox Guarding the Hen House

Paulsen challenges the increasingly popular tendency to view construction management as the solution to familiar design/construction conflicts. He cites three reasons for this position:

- Break in trust – why do owners pay someone they don't trust?
- wasted energy – time and expertise are not geared toward delivering value
- owner's best interests – hidden agendas, design awards, value engineering and scope reduction.

Recommended Alternative

Not surprisingly, Paulsen recommends a combined design-plus-construction approach in which "the architect is providing a professional service through design and construction, with no financial incentives to skimp on quality."

Paulsen added that an integrated design/build approach, though dominant in other industries, is far from common in the school market.

Benefits of Integrated Delivery

Paulsen's argument for integrated architectural/engineering and CM services included discussion of the following points:

- Architect as master builder – a concept long talked about but seldom achieved
- efficient process to control – scope, budget, and schedule
- single accountability – one call does it all.

When the architect serves as master builder in partnership with the owner, the desirable results include seamless coordination of all elements, streamlined decision-making, total program budget control, and the opportunity to guarantee results.

Case Study: Country Club Hills, Illinois

Paulsen presented a case study in which two government agencies in Country Club Hills, Ill., worked together on a school addition. The park district and the school district developed an intergovernmental agreement to jointly fund and operate a school addition that would be used for both educational and community recreation purposes.

The school district contributed funding that it had previously secured from the state of Illinois, and the park district sponsored a bond referendum.

On this project, Sverdrup served as the design manager, construction manager, and project director. Paulsen cited three significant benefits of the integrated delivery approach provided by Sverdrup:

- A single point of contact and responsibility
- total project delivered under guaranteed price
- open public bidding atmosphere.

The Scheduling Dilemma: Construction Without Disruption

Scheduling the work is often as much of a challenge as the work itself, according to John Heidbreder, who served as project director on the fast-paced, $1.6 million renovation of Lindbergh High School in St. Louis.

Understanding Client Needs

Although a complete understanding the client's needs is always important, it was crucial on the Lindbergh High School renovation project. Heidbreder discussed needs and constraints under four broad headings:

- Bond issue promises
- court mandates
- type of work required
- role of staff and board in approval process.

Fast-Paced Schedule

What school renovation project *isn't* fast-paced? The schedule at Lindbergh was a standard three-phased one:

Design	5 months
Bid & award	3 months
Construction	12 months

Heidbreder noted that the bidding process took longer than usual, even though the school board worked closely with the builder throughout the entire project.

Common "schedule-busters" listed by Heidbreder:

- Bids over budget
- asbestos
- summer programs
- late material deliveries
- permitting/easements, e.g., sewer extension
- an insufficient number of students vacating the premises.

Laborers charge a premium to work nights, typically 5 percent to 10 percent more. Nonetheless, Heidbreder maintains that night work on school projects is more time and cost efficient because of fewer interruptions by students, teachers, administrators, parents, and visitors.

Scheduling the Work

By definition, the type of work to be done drives schedule development. The Lindbergh project included work on classrooms, the building envelope, and infrastructure. Factors that can affect the schedule include funds, time, materials, manpower, and space. Space is especially important if part of the building will be occupied during construction, which is almost always the case with schools.

On Heidbreder's schedule, work on the building envelope came first and covered the roof, windows, tuckpointing, waterproofing, and structural deficiencies. Work on Lindbergh High School's infrastructure, meanwhile, included the central plant, power and service upgrades, in-classroom systems, and systems such as security and fire alarms.

Conclusions

The veteran of many complex, fast-paced school renovation/construction projects, Heidbreder offered the following advice to session participants:

- Understand the client's needs
- be flexible and creative
- involve everyone in planning who will be affected by the construction
- be prepared to change your plans to accommodate changing needs and conditions.

School Houses That Will Live On

Preserving that which is valuable is the unifying theme of sessions in this focus topic, including valuable resources like land, water, air, natural gas and electricity, existing buildings, architectural nuances, capital improvement funds, and operating revenues.

One speaker demonstrated the successful retrofit of existing school buildings to accommodate today's technology requirements. Another spoke of building ecology and the need to continually reduce, reuse, and recycle. A third speaker explained how today's renovation purchases can be paid for with tomorrow's energy savings.

Integrating Today's (and Tomorrow's) Technology Into Yesterday's Buildings: Lowell High School,

A Case Study in Transformation

Lowell, Mass., is an old mill town an hour north of Boston with a progressive school board, as reflected in their district-wide goal of equipping every classroom with PCs and establishing distance learning capabilities at every school.

By the time Jerry L. Clement, Principal, K-12, Educational Facilities for St. Louis-based Sverdrup Facilities Inc. became involved with Lowell, the board had already completed work on all elementary and middle schools and was ready to tackle Lowell High School. The school consisted of a mix of buildings dating from 1896 to 1980, situated on a campus bisected by a historical canal.

Commitment to Technology

The school district committed to installing voice, video and data technology in every classroom. This included Intranet/Internet access, broadcast/receive video capability for distance learning school-to-school, and computer data ports.

While describing the transformation of Lowell High School, Clement noted that schools built between 1960 and 1980 are no easier to refit for technology than are pre-WWII buildings. In fact, they may even be harder because of their minimal interstitial space and low ceilings. The small classrooms are often inadequate to accommodate the additional space requirements of computers; previously, 30 square feet per student was deemed adequate, but the presence of PCs in the classroom has bumped the minimum up to 40.

Programmatic Challenges

Three current trends in educational programming require a redefinition of classroom space and more flexibility:

- No more teacher as lecturer
- focus on project-based learning
- cooperative work as in the real world.

A flexible classroom environment might incorporate four or five cluster seating arrangements and study carrels for individual research, in addition to a facilitator's station for the teacher and conference-table seating. PCs, video equipment, and bidirectional speakers would be positioned throughout the environment. Such a set-up allows students to function as teams, merge into larger groups, or explore individual study.

The resulting design resembles real-world office space. Student teams compare to corporate work groups, and classroom furnishings are similar to modular systems and cubicles in the business world.

High-End Technology Model

The Lowell School Board made a significant commitment to technology for their high school students, equipping 450,000 square feet of classroom space as follows:

- Six to 16 ports per classroom
- network topology that included a fast Ethernet with switched, managed ports
- Windows NT operating system
- LAN speed of 100 Mbs at the port
- WAN connection
- T1 for data and the Internet
- 10 Mbs to Central Administration.

System Design

Establishing Lowell High School's network included several considerations. The board did not want a maze of cabling overhead, it wanted a fiber optic backbone from head-end to the data closets, and it wanted to upgrade the elecrical system to handle 28 computers per classroom. The distance between the separate campus buildings and cramped overhead space complicated the challenge.

Clement exhorted attendees not to cut corners on cabling. As he explained, cabling represents only 5 percent of the total technology budget (which includes cabling, PCs, software, mainframe), yet it has the greatest impact on performance and is expected to last the longest of all components.

Unexpected Problems

Coburn Hall, the most historical campus property, was constructed of heavy timber. The State Building Assistance Authority initially would not approve the replacement cost, but gutting the original structure would have added $9 million to the $40 million budget. Through extensive engineering calculations, Sverdrup proved to the authorities that minor modifications would render the existing structure safe and code-compliant.

A second set of challenges involved the legacy of renovations completed in the 1970s, including more than $600,000 in incomplete asbestos abatement, abandoned cable ducts, and through-wall bolts in exterior walls that caused leaks and rust.

The Results

Renovations in the newer school buildings included reconfigured labs, new lighting in all classrooms, and the transformation of an existing locker area into a two-story multimedia center. The reconfigured labs included more lecture space and updated technology. Classroom lighting featured pendant fluorescent bulbs, dimming ballasts, and photocells.

Technology installations were identical campus-wide. Additional renovations to the turn-of-the-century buildings reversed some of the modifications made in the 1970s:

- Raised ceilings to their original height (had been dropped to eight feet)
- reopened original light shafts
- installed Fl light fixtures in classrooms
- reconfigured some interior spaces for teacher centers.

Today, every classroom in Lowell High School has voice, video, and data connections; computers on two walls; the potential for 28 PCs, and broadcast/receive video capability for distance learning.

School Renovation and Building Ecology

Sarah Woodhead, AIA, principal of Sarah Woodhead Architecture and Planning, based in Washington, D.C., defined building ecology as "the interrelationships between people, the built environment, and the natural environment." Woodhead also serves as senior associate for the 21st Century School Fund in Washington, D.C.

According to Woodhead, building ecology factors include:

- Atmospheric impacts
- water use and quality
- resource conservation or depletion
- biodiversity impacts
- human health effects
- energy use
- land use

- waste generation
- soil pollution
- socioeconomic impacts.

Woodhead compared schools built during three different periods – pre-WWII, the baby boom years, and the era of open-space structures – on the basis of four factors: human health, energy, land, and socioeconomics.

Human Health

In general, Woodhead noted, education administrators and designers were more attentive to human health concerns prior to World War II than since. Issues span:

- Indoor air quality (IAQ), which includes temperature, humidity, ventilation, and VOCs
- daylighting
- hazardous materials
- acoustics
- finishes.

Woodhead suggested establishing the intended lifespan for the project as a gauge for decision-making. For example, a longer intended life justifies using more durable materials, even if the materials are higher in embodied energy. In addition, she said, it is important to build for realistic adaptability, determine the needed degree of flexibility for educational spaces, and recognize the limitations of available information.

She noted that "green" materials should only be used if they meet traditional performance standards, and recycled and local materials should be used whenever possible. The use of natural light should be emphasized. Furthermore, VOCs should be limited by avoiding such things as carpeting and particleboard that contains formaldehyde.

Additional Information

Woodhead referred conferees to additional Internet resources:

- *Environmental Building News* at www.ebuild.com
- Green Building Council at info@usgbc.org

Alternative Funding Possibilities: Public/Private Development Partnerships and Others

Citing typical shortages of revenue for school renovation, Mary Filardo, director of the 21st Century School Fund, and Deborah Chollet, codirector of the St. Louis-based Mid-American Energy and Resource Partnership, discussed options and resources available through public-private development partnerships, sale-leaseback agreements, and performance contracting.

Traditional Sources of New Revenue

Setting the stage, Filardo reviewed the traditional sources of revenue for school renovation:

- Federal, where none of the "usual" funding is currently available
- state, which typically means grants from the general fund or allocations from state bond proceeds
- local, which generates funds by raising local property taxes to support bond issues or allocating higher proportions of operating budgets to facilities.

These resources, unfortunately, are usually inadequate to meet local school renovation needs.

Alternative Routes to New Revenue

There is some hope, however, in terms of alternative resources.

On the federal level, Qualified Zone Academy Bonds are available, and 13 bills have been introduced into the 106th Congress, all of which would support the cause.

Options on the state level include scrutinizing new revenue, e.g., tobacco settlements and acquiring surplus from a general fund.

However, most of the activity is occurring on the local level, as school districts raise revenue, reduce costs, or both, by selling or leasing underutilized assets, scrutinizing new revenue, and entering into performance contracts.

Public/Private Development Partnerships

Organizations involved in public/private development partnerships with school districts include HUD, local universities, and community development agencies. Such partnerships can raise revenue in two ways: sell or lease underutilized assets, or generate new taxable assets for the school district.

They can lower costs by using the private sector to manage design, construction and procurement, with public school oversight; or combining school construction with larger projects to create economies of scale.

Sale Lease-Back

The sale of public assets could generate revenue for school construction/renovation. Cost-reducing approaches require capturing the private sector's motivation for productivity and efficiency, or receiving a 15 percent equity contribution by the private sector owner.

According to Filardo, approximately 10 percent of all schools in Nova Scotia are taking advantage of sale lease-back arrangements. Under such a set-up, the school sells the land to a private developer, who develops the property and then leases it back to the school.

Performance Contracting

The funding option to which Filardo and Chollet devoted the most attention during their presentation was performance contracting.

As defined by the U.S. Department of Energy, a performance contract is a legally binding arrangement in which an Energy Services Company (ESCO) agrees to carry out lighting retrofits, building renovations, HVAC equipment upgrades, maintenance, or other services. In exchange, they are repaid through the resulting energy cost savings. Performance contracting can be viewed, in essence, as a purchase paid for out of future energy savings, supporting the view that "energy efficiency is an investment, not an expense."

Survey statistics cited by Chollet indicate a significant opportunity for savings through energy conservation: 70 percent of the energy used by schools is gas, although gas represents only 30 percent of their total energy cost. Conversely, only 30 percent of the energy used by schools is electricity, although it accounts for 70 percent of the total energy tab.

There are four types of ESCOs: vendor-based; utility-based; trade-based, e.g., electrical and mechanical contractors; and independent developers such as A&E organizations and developers.

Eligible Improvements

Simple paybacks of less than seven years can often be achieved on lighting renovations, boiler modifications, HVAC improvements, water and sewer conservation, and building controls.

Investments in replacement windows, new roofs, and new boilers typically involve a longer payback period.

Obstacles to Implementing Energy-Efficiency Plans

As with any venture, pioneers will have obstacles to overcome. Chollet described several such impediments. For example, some bad projects have received considerable press, the effects of which might need to be mediated in order to garner supporters. In addition, researchers could run into a lack of information about the district's utility use, other educational issues may have broader appeal than energy efficiency, or efforts to take advantage of a performance contract could be thwarted by the need for up-front money.

Benefits Outweigh Obstacles

Performance contracting, together with public private development partnerships and sale lease-back agreements, are generally felt to be worth the effort. Benefits include:

- New revenue
- leverage of assets and savings
- private sector involvement in applying development techniques and building technologies.

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